Table 3

UPTAKE OF $^{36}Cl^-$ FROM PLASMA TO CSF. PLASMA COUNTS AT 12 MINUTES IN CONTROLS SET AT 100.

	Concentration units						Cl^- conc. (mM)	
	12 min	30 min	1 hr	2 hr	3 hr	6 hr*	0 time	3-6 hrs†
Controls								
Plasma (n = 6)	100	81	68	58	52	41	239	246
CSF (n)	4	10	-	14	20	39	-	263
	(2)	(1)		(2)	(1)	(6)		
Acetazolamide at -30 min								
Plasma (n = 6)	120	102	85	68	60	48	240	244
CSF (n)	6	12	-	23	34	31	-	253
	(2)	(1)		(1)	(1)	(6)	(n = 9)	

*The difference in plasma/CSF counts between control and treated fish at 6 hours is significant at the level of P between 0.05 and 0.1.

†The difference in CSF Cl^- concentration between control and treated fish is significant at $P < 0.05$.

acetazolamide in decreasing CSF flow in this species is relatively small (Oppelt, et al, Comp. Biochem. Physiol. 17:857, 1966).

We conclude that the carbonic anhydrase system is involved in the rapid accumulation of HCO_3^- ion in the CSF; the physiological significance of this is not certain, but a reasonable possibility is its role in the control of respiration (cf. Pappenheimer et al, Am. J. Physiol. 208:436, 1965). A role of this enzyme in Cl^- accumulation is also suggested. It is the reduction of ionic movement by acetazolamide that is responsible for the decrease in CSF flow.

Supported by NIH grant GM AI 16934-01.

1969 #24

EFFECT OF A DILUTE ENVIRONMENT ON CEREBRO-SPINAL FLUID AND BRAIN ELECTROLYTES IN THE ELASMOBRANCH, *Squalus acanthias*

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Elasmobranchs are capable of surviving over a broad range of osmotic environments. Short term experiments have shown that the lemon shark and the marine skate are capable of survival in dilute sea water. No studies are available concerning the impact of a dilute environment on the electrolyte metabolism of the cerebro-spinal fluid or of the brain. Such data should be important since maintenance of a normal electrolyte environment in the brain would be critical for survival of the animal. Accordingly, the effect of a dilute environment on steady state concentrations of sodium, potassium and chloride in the cerebro-spinal fluid and brain and of water content of the brain in marine elasmobranchs was studied.

A total of 18 adult female spiny dogfish were studied. Ten animals served as controls, and eight animals constituted the experimental group. Each animal was placed in its respective environment, normal sea water or dilute sea water, within 24 hours of capture by hand line. The animals were maintained in their respective environments for four days at 12° C, with the controls in fresh running sea water, five of the experimental animals in approximately 70% sea water, and three of the experimental animals in approximately 40% sea water. The dilution of sea water was determined by chloride measurements of the diluted sea water compared to fresh sea water. Blood samples were obtained daily for determination of plasma sodium, potassium and chloride concentrations to insure the achievement of a steady state. The animals remained active during the four days of observation, and arterial blood pH measurements that were done in five animals were within normal range. At the end of the four days of each environment the animals were sacrificed and blood, brain and cerebro-spinal fluid were processed. Water content of plasma and brain was obtained by drying the sample at 100° C to a constant weight. Electrolyte concentrations were determined in the liquid phase of a nitric acid digest of the brain.

The results of the analyses are presented in the table. The values for plasma and brain electrolytes and water content in the control animals were in agreement with previously reported data. Exposure of animals to dilute sea water led to a significant increase in brain water content. Plasma water content was also increased in the 40% sea water animals.

TABLE GIVING MEAN VALUES

	Sea water	mEq/L plasma H20	mEq/L CSF	Ratio CSF/plasma	mEq/L Brain H20	Ratio Brain/plasma
Sodium	100%	289	311	1.04	125	0.43
	70%	289	277	1.02	117	0.44
	40%	215	211	0.98	102	0.47
Potassium	100%	5.2	5.7	-	115	22
	70%	5.0	5.1	-	104	21
	40%	4.6	4.8	-	97	21
Chloride	100%	266	285	1.07	105	0.39
	70%	243	254	1.05	109	0.45
	40%	201	205	1.02	90	0.45
% H_2O	100%	93.0	-	-	79.0	0.85
	70%	-	-	-	81.3	-
	40%	95.6	-	-	83.7	0.88

It is of interest that in the condition of a dilute environment plasma and cerebro-spinal fluid sodium and chloride decreased proportionately but there was no measurable change in potassium concentration. The ratio of cerebro-spinal fluid electrolyte to plasma electrolyte concentration remained the same for each electrolyte species studied. Change in brain electrolyte concentrations changed less than the changes in plasma or cerebro-spinal fluid electrolyte concentration even though brain water content increased more than plasma water content increased.

Accordingly, the ratio of brain to plasma concentration of sodium and chloride in the fish in dilute sea water increased above ratios found in control fish. Simple dilution by intake of water does not explain these findings.

1969 #25

OBSERVATIONS ON THE SPINE OF Squalus acanthias

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In 1924, Evans described in detail a poisonous gland located in the deep concave groove of the dogfish (Philos. Trans. Royal Soc., London, Series B 212:8-16, 27, 1924). This report has been cited from time to time by other authors despite considerable doubt that such a gland exists.

In the spiny dogfish a typical posterial dorsal spine is 3.2 cm long and about 0.1 cm in diameter at the tip (Figure 1). At the level of the epidermis the shaft has a diameter of 0.4 to 0.5 cm. Below the epithelial surface the shaft extends for another 4.0 cm to articulate with the ver-

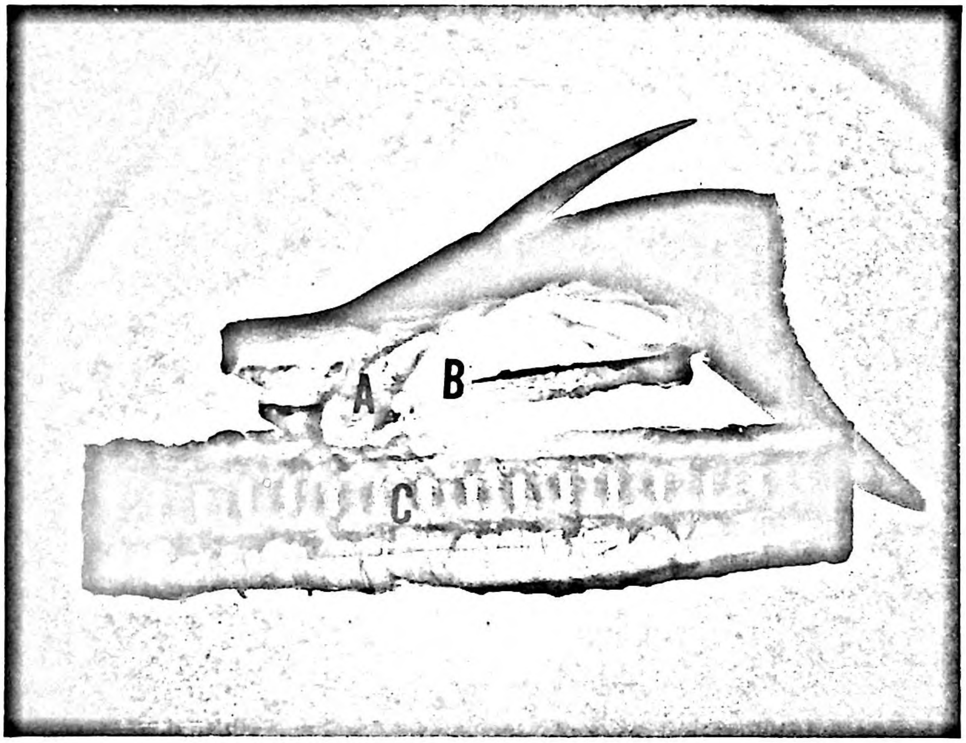

Figure 1. Posterior dorsal fin and dorsal spine of the dogfish. (A) Dorsal spine. (B) Dorsal fin cartilage. (C) Vertebral column.

tebral column and posteriorly with the dorsal fin cartilage. The anterior dorsal spine is similar to the posterior spine but is a centimeter or two shorter (Figure 2). The anterior dorsal fin, however, has a much longer articulation with the vertebral column than the posterior dorsal fin.

The dorsal spine consists of a central core of hyalin cartilage bordered by a zone of loose connective tissue (Figure 3). Surrounding these elements is a hard shell of dense acellular